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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the manufacture approach of Ru target for sputtering for forming Ru thin film used for the electrode of KYAPASUTA thin films, such as semiconductor memory, etc.

[0002]

[Description of the Prior Art] The crystal structure of Ru is a lattice of hexagonal closest packing, and in ordinary temperature, of course, even an elevated temperature 1000 degrees C or more is difficult plastic working, and tends to break, and it is a weak metal. Moreover, work hardening is intense and has the property in which cutting ability is very bad, the top.

[0003] On the other hand, the magnitude for which the target for sputtering is usually needed in proportion to the magnitude of the size of Si wafer which is a workpiece is decided, and, generally the ratio is about 1.5 at a diameter. Let twice be common sense.

[0004] In recent years, the diameter of 6 inches and 8 inches are usual, and size of Si wafer is made indispensable [ near future 12 inch size ]. For this reason, it is necessary to make a thin ingot from a large area, but the melting point of Ru is as high as 2250 degrees C, and it is C. It is easy to react with the metal of Si, aluminum, and others, and since the crucible [ like ] which can be operated without making the molten metal of Ru pollute does not exist in the present life, dissolution casting is not employable.

[0005] Therefore, although it is possible to adopt the arc dissolution using water-cooled copper Haas, and an electron beam solution process, it is difficult to cast the plate of a large area in these approaches thinly, since irregularity arises on a front face.

[0006] Moreover, to sinter powder and to make the disk of a large area is also tried. In this case, since at most 1200-1300 degrees C were not sintered and spread at the temperature of max in case there is no equipment which can sinter a fully high quality target and the disk of a large area is sintered, since Ru is contacted at this temperature and the stable structure is not found physically and chemically, although it is desirable to compress at 1500-2000 degrees C as for sintering of Ru powder, whenever [ precise ] was low and it was difficult to make a good target.

[0007]

[Problem(s) to be Solved by the Invention] Then, this inventions are the diameter of 12 inches, and the target of large areas, such as 15 inches and 18 etc. inches, and whenever [ precise ] is high and they tend to offer the manufacture approach that good Ru target for sputtering without an internal defect can be obtained.

[0008]

[Means for Solving the Problem] Although Ru is a rare metal and the property is seldom known, this invention persons Ru is C at an elevated temperature in the process in which many Ru metals are dissolved and cast. It is the C, when dissolving the metallic element of Si and others and cooling and solidifying it. It deposits in some of Si and other impurity elements, Moreover, the gas of O<sub>2</sub> or H<sub>2</sub>

grade reacts, it absorbs so much, there is a property to produce air bubbles inside at the time of cooling, or to deposit in the grain boundary, and it found out that it was the factor which embrittles an ingredient further. The approach of surfacing as an oxide the impurity of the gas constituents and the active metal which deposited Ru inside Ru by repeating dissolution coagulation in a vacuum, and on the other hand removing it was found out. And as a result of inquiring wholeheartedly about the dissolution approach, it could heat slowly from the front face, and the melting area could be enlarged most, and, moreover, it found out that the vacuum plasma dissolution was most suitable as the dissolution approach of not making Ru polluting from a crucible. As a result of examining various welding processes as an approach of furthermore forming a large area target, the weld flaw tended to be dependent on the ingredient, and conventionally, when electron beam welding of the ingot made by the sintering approach was carried out, it turned out that an internal defect arises. It turned out that especially the thing that a pinhole, a crack, and inclusion produce also in the weld bead when the ingredients containing gas or an impurity are welded to the interior is not avoided. it was alike, and when it was the appropriate ingredient which dissolved with the aforementioned vacuum plasma melting process, even if it performed electron beam welding, it found out that it was possible to make what does not have a defect in the interior.

[0009] This invention is the manufacture approach of Ru target for sputtering developed paying attention to the above point, and is 2. The dissolution and coagulation are repeated more than a time, Ru ingot is made, grinding of the front face of this Ru ingot is carried out, and it is characterized by making a plate, welding this plate as a material, large-sized-izing it, and obtaining Ru target for sputtering.

[0010] In the manufacture approach of Ru target for sputtering of above-mentioned this invention, it is desirable that the arc dissolution and the time [ 2nd ] dissolution are [ vacuum plasma dissolution and welding ] electron beam welding or arc welding for the time [ 1st ] dissolution.

[0011] In the manufacture approach of Ru target for sputtering of above-mentioned this invention, it is desirable that the dissolution after the 1st time and the 2nd time is [ welding ] electron beam welding or arc welding in the vacuum plasma dissolution.

[0012] It is also possible to perform all also of the dissolution after the 1st time and the 2nd time and junction of two or more ingots in a vacuum plasma fusion furnace by the manufacture approach of Ru target for sputtering of above-mentioned this invention, and this is also a desirable approach.

[0013]

[Function] By the manufacture approach of Ru target for sputtering of this invention, once fusing Ru powder by the arc dissolution or the comparable low voltage plasma dissolution in Ar ambient atmosphere of 100 - 500Torr, gas and the impurity active metals which carry out occlusion to the interior deposit by raising a degree of vacuum and dissolving Ru front face several times in Ar gas ambient atmosphere of 10-3Torr extent. In this way, the obtained ingot has a smooth front face and can also process the thing of a large area in water-cooled copper Haas comparatively. And a healthy ingot without an internal defect especially a shrinkage cavity, the contamination of air bubbles and an impurity, etc. is obtained. Moreover, by the manufacture approach of Ru target for sputtering of this invention, in order to enlarge area, in case the plate which carried out grinding of the above-mentioned ingot, and obtained it is welded, a large-sized sputtering Ru target without an internal defect is obtained by carrying out electron beam welding in low voltage Ar gas. Since the point which is excellent in electron beam welding has the high energy density, it is that can form a molten metal in the depth direction greatly by the narrow beam, and path clearance of a weld zone is made to min. That is, when carrying out butt welding of the two jointed material, a plane of composition is polished with a sufficient precision at a flat surface, and after comparing and sticking this 2nd page, welding without an internal defect is attained by welding an interface from an outside. It is saying that it recommending from the result this invention person's etc. having done test research repeatedly, and being able to say in general will become the cause which involves air bubbles, an impurity, etc. in the interior of a weld zone, and produces weld flaws, such as a void, impurity mediation, and hair cracking, if a defect's exists in the interior of an ingredient.

[0014]

[Embodiment of the Invention] The operation gestalt of the manufacture approach of Ru target for

sputtering of this invention is explained. Purity They are 500Torr(s) about 99.97% of Ru powder. It is 10R in Ar arc fusion furnace. Put in about 10g at a time, carry out the arc dissolution, water-cooled copper Haas with a semi-sphere-like depression is made to solidify, and it is marble with a diameter of about 10mm 200 Individual creation was carried out. Next, it is 100 to 80wx160l.x20h water-cooled copper Haas in a vacuum plasma fusion furnace. The marble of an individual is put in order. After carrying out vacuum suction to 10-6Torr, Ar gas is introduced to 10-3Torr. Melting coagulation is repeatedly carried out until Ru droplet stops occurring completely from a front face and a rear face with the vacuum plasma, and they are finishing, width of face of 75mm, and die length evenly about an ingot front face. Two tabular ingots of 150mm, the 6mm of the thickness minimum sections, and the 10mm of the maximum sections were created. About these two tabular ingots, grinding of a front face and the rear face was carried out at the surface grinder, and it became monotonous [ 3mm thickness ]. the monotonous end face of two sheets was evenly compared with a sufficient precision after finish wooden clongs with the surface grinder after that, electron beam welding was performed, diameter 100 mm and a disk with a thickness of 3mm were cut down with the abb RESSHIBU water jet cutting machine from this plate that created the 150wx150l.x3t plate, and Ru target was obtained.

[0015] It is X about the weld zone and the whole surface of Ru target which were obtained by the above-mentioned manufacture approach. As a result of observing with a line transparency photographic method, a joint does not have a defect and it was checked that faults of a plate, such as air bubbles and mediation of an impurity, are the healthy things which are not accepted at all.

[0016] The above-mentioned Ru target was very attached in magnetron sputtering equipment, as a result of performing sputtering and making a 1000A thin film form on a 3 inch Si wafer, there is also no abnormality discharge the middle and membranous quality was also able to obtain good Ru film. moreover, even after carrying out long duration use of the Ru target, the front face is exhausted uniformly, and a weld zone is \*\*\*\* -- unusual phenomena, such as a projection by \*\* and the foreign matter, were not seen at all.

[0017] Although there is generally a problem which causes abnormality consumption, and \*\*\*\* arises, or a weld flaw surfaces on a front face and produces abnormality discharge with the target of other metals since the part and metal texture of others [ weld zone ] differ from each other when it welds It is imagined easily that the base material section is also dissolution cast structure, it has become with the organization of a weld zone and the same cast structure as an essential target since Ru target made by the manufacture approach of this invention is not performing plastic working at all, and it did not produce abnormality consumption.

[0018]

[Effect of the Invention] Since the plate which welding of a target of by which taboo \*\* has been carried out in order that an internal defect may remain was attained, and made the target of a large area from other metals and alloys other than Ru with the existing facility conventionally is obtained electron beam welding or by carrying out arc welding according to the manufacture approach of Ru target for sputtering of this invention so that it may understand by the above explanation, whenever [ precise ] is high, and good Ru target without an internal defect can be obtained cheaply economically.

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[Translation done.]